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EFFECTIVENESS OF FOOD SECURITY POLICIES IN IBSA AND BANGLADESH

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ABSTRACT

The paper examines food security in terms of its three basic indicators, viz., availability, accessibility and absorption, across IBSA countries and Bangladesh, which together account for nearly a quarter of the world's population and more than one-third the undernourished. It also analyses the determinants of prevalence of food inadequacy in these countries. The study is based on data drawn from FAOSTAT, World Development Indicators (World Bank) and Global Food Security Index 2016 for the period 1990-2016. The objectives of the study have been analysed using ratios, percentages, simple average and multiple regressions. The results of the study indicate Brazil to be leading in achievement of the three indicators of food security indicators, whereas India and Bangladesh lag behind in most of the parameters. The determinants of prevalence of food inadequacy revealed that while increase in GDP per capita significantly reduced food inadequacy, growth in population significantly increased it in Brazil. Value of food production and targeted policies ensuring food security emerged as the most significant factors reducing prevalence of food inadequacy in most of the selected countries. The study recommends increasing food production and effective implementation of the food security policies by the four countries. Above all, these countries could also benefit from sharing each others' best practices.

Keywords: *food security; availability; accessibility; absorption; food inadequacy*

INTRODUCTION

Food insecurity is a severe problem ailing not only by the developing, but also the developed countries. It is one of the Millennium Development Goals, which is yet to be accomplished by most countries of the world. The World Bank (1986) defines food security as, "access by all people at all times to enough food for an active and healthy life". According to Food and Agriculture Organization (FAO, 1983), "food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life", which was adopted in World Food Summit 1996. IBSA is a tripartite grouping among the emerging economies of India, Brazil, and South Africa (IBSA) for promoting international cooperation among them. It is a unique Forum of three democratic nations from three different continents, facing similar challenges. Bangladesh, a member country South Asian Association for Regional Cooperation (SAARC), which includes India as well, shares similar common problems of poverty and food insecurity with IBSA countries. Food security for the IBSA countries and Bangladesh is of great importance, as together they account for 23.18 percent of the world population (World Bank 2014) and 41.40 percent of the undernourished (FAOSTAT, 2015). Hence, the four countries assume a crucial role in over-coming global food insecurity. Each of these countries have launched several multi-dimensional strategies, focusing on each indicators of food security, including various rights-based approaches and involvement of multi-stakeholder (Souza and Chmielewska, 2011).

Food security comprises three basic indicators – availability, accessibility and absorption (FAO, 2015). Availability refers to enough stock of food available to meet the demands of food requirement of a country through production or import. The National Food Security Mission (NFSM) adopted by India in 2007, aimed at increasing production of crops like wheat and pulses on a sustainable basis to ensure food availability, is one such initiative (Government of India, 2005). The Poverty reduction strategy paper in 2005 (PRSP-2005) in Bangladesh is focused on creating sustainable environment, and supporting transformation of subsistence agriculture. Its Agriculture Input Assistance Card Program (2010) was introduced to provide cash subsidies to the poor small and medium farmers through bank accounts opened for 10 takka, aims at ensure self-sufficiency in food and eliminating misappropriation of financial support (Muniruzzaman, 2013). In Brazil, the National Programme for Strengthening Family Agriculture (PRONAF) initiated in the 1990s helped family farmers to increase their acreage and production, which had remarkable effect on its agriculture by disciplining them financially and encouraging efficient utilization of resources and promoting consolidating family farms (Guanziroli and Basco 2010). South Africa initiated the Reconstruction and Development Programme (RDP) in 1994 that integrated a holistic strategy of reconciliation, reconstruction, redistribution and development with the major food security programme. It also included "land reform and farmer settlement, production loans scheme for small farmers, infrastructure grant for smallholder farmers and the Presidential tractor mechanization scheme" (O'Malley, 1994).

Despite availability of sufficient food stock, wide income inequality makes food inaccessible to a vast majority of population living in poverty in most countries of the world. The accessibility indicator of food security relates to distribution of food to all sections of the people in a country (Krishnaraj, 2005). Schemes like Targeted Public Distribution Scheme (TPDS 1997), Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA, 2005), besides various other poverty alleviation schemes in India aim at reaching those without food (Mittal and Sethi, 2009). The Bangladesh Food-For-Work (FFW) program launched in 1975 is aimed at creating employment and paying in kind (i.e., in wheat), especially during the lean season, under the nation-wide Rural Maintenance Program (RMP) through river embankments construction, irrigation channels and maintenance of rural roads, with the purpose of stabilizing food grain market prices, besides improving food consumption and nutrition of the beneficiary households. In the wake of prevailing wide income inequality in Brazil, Fome Zero (Zero-Hunger) Program was launched by President Luiz Inácio Lula da Silva in January 2003, which has been one of the most effective policies in reducing poverty and hunger (Meade *et al*., 2003; Rocha 2009; Sharma and Gulati, 2012; de Souza *et al*., 2015). The Integrated Food Security Strategy of 2002 aims at achieving "universal physical, social and economic access to sufficient, safe and nutritious food by all South African at all times to meet their dietary and food preferences for an active and healthy life" (Department of Agriculture 2002). It also covers "increasing household food production and trading; improve income generation and job creation opportunities; improving nutrition and food safety; increase safety nets and food emergency management systems; improving analysis and information management system; providing capacity building and holding stakeholder dialogue" (McLaren *et al*., 2015).

Achievement of the availability and accessibility indicators does not necessarily indicate absorption or utilization of nutrition, which involves several factors like pregnant women's health condition, hygiene, child's diet intake during infancy, drinking water and sanitation (Dev and Sharma, 2010). Since the daily minimum calorie intake considered for adequacy of food becomes insufficient to address the growing malnutrition, Centrally Sponsored nutrition based measures like the Integrated Child Development Services (ICDS, 1975) and mid-day meals scheme (September 2004) were introduced by the Indian government to address nutritional deficiencies (Mittal and Sethi, 2009), covering the malnourishment among school children and children below five years of age (Dev and Sharma, 2010). The Bangladesh government launched the strategic orientated food security policies, viz., National Food Policy (2006) and National Food Policy Plan of Action (2008-2015), with the objectives of sufficient and "stable supply of safe and nutritious food; increased purchasing power and access to food; and adequate nutrition for all, particularly women and children", which has resulted in progress in rice production, reduced the prevalence of malnourishment and underweight among children,

and helped in identifying areas requiring international donors focus (Muniruzzaman, 2013). South Africa's National Schools Nutrition Program (1994) aims at providing a wholesome food security programme for students' health and improving their school attendance, through creating nutrition awareness, and involving teachers and parents as well in the process (Department of Basic Education, 2016). The School Feeding Programme in Brazil, launched in 1954, aimed at decreasing the number of malnourished children and improving the school enrolment rate in 2003, it was integrated with the national Zero Hunger Program (Sidaner *et al*., 2013).

Studies indicate that the integrated strategy adopted by the Brazilian government for food security, focusing on including availability, access and absorption under a single social security programme named Zero Hunger, contributed to the over-all social development of its people by increasing the purchasing power of the poor and increased food supply through family farms investments schemes (Meade *et al*., 2003; Rocha, 2009; Sharma and Gulati, 2012). Although South Africa is considered to be a food secure country, a large number of households still suffer from the problem of food insecurity, due to high income inequality and poor distribution of food and other resources in the country (Dube, 2013). Despite the launching of the various policies by the government of Bangladesh to combat poverty and hunger through agricultural development and social security schemes, Nath (2015) reported the country to be suffering from triple burden of food insecurity, viz., malnourishment due to poor food intake; underweight; and micronutrient deficiency. Studies on India reveal that three-fourth of India's population suffer from under-nutrition (Deaton and Dreze, 2009), which can neither be attributed to lack of income nor high food prices, but is due to lack of awareness among the people (Dev and Sharma, 2010; Chand and Jumrani, 2013). Further, the various schemes implemented are also slow in impact due to corruption, errors in selection, leakages, poor allocations and very low accountability (Saxena, 2011). Given the significant similarities and differences, and the various public policy approaches adopted, investigating the issue of food security among the IBSA countries and Bangladesh is deemed important for enriching their policy approaches. In the back drop of these issues, the objectives of the present paper are: 1) to overview the various dimensions of food security, in terms of availability, accessibility and absorption, in IBSA countries and Bangladesh; 2) to assess the effectiveness of the various policy interventions for increasing food security in the selected countries; and 3) to analyse the factors influencing prevalence of term.

RESEARCH METHOD

The study is based on data drawn from FAOSTAT, World Development Indicators (World Bank) and Global Food Security Index 2016 for the period 1990-2016. The objectives have been analysed using simple averages, percentages, ratios and ordinary least squares multiple regression. The determinants of prevalence of food inadequacy have been analysed separately for the IBSA countries and Bangladesh using the following equation:

$$PFIDQ = a_0 + a_1\,GDPPC + a_2\,POPGR + a_3\,FOODM + a_4\,AVFPD + a_5\,UEMPR + a_6\,POLCY + u$$

where,

PFIDQ = prevalence of food inadequacy in percentage;
GDPPC = GDP per capita in current USD in log form; POPGR = population growth (annual %);
FOODM = total food imports at current price in USD in log form;
AVFPD = average value of food production (1$ per capita); UEMPR = unemployment rate (% unemployment);
POLCY = food security policy dummy, taking value one for year from which a significant food security policy was implemented, and zero otherwise [Brazil - 2003 Zero Hunger Program; Bangladesh – 2005 National Food Policy; India – 1997 Total public distribution schemes (PDS); and South Africa - 2002 Integrated Food Security Strategy (IFSS)]; and
U = error term.

Prevalence of food inadequacy is defined as the percentage of people with inadequate access to food. It only represents the average prevalence of food deficiency among the people in general (FAO, 1996). In the present study it is used as a narrow proxy for food insecurity, due to the lack of all required data for the selected study period for constructing the index.

The expected association between the sets of independent and dependent variables are as follows. Rise in GDP per capita is hypothesised to reduce prevalence of food inadequacy among the people, due to increased income. Whereas, higher population growth rate is expected to decrease it, due to the resulting increase in demand for food. Rise in total food imports is likely to decrease food inadequacy, owing to higher food supply.

Other things remaining constant, higher average value of food production is expected to decrease food inadequacy, as it would encourage more food production. However, the influence of exchange rate fluctuations on imports is also likely to render the nature of association indeterminate. On the other hand, higher unemployment rate is likely to increase food inadequacy, owing to the resulting lack of effective demand. Meanwhile, adoption of targeted policies aimed at overcoming food insecurity by the selected countries are expected to have a negative impact on food inadequacy, given their objective of making the poor food secure.

RESULTS AND DISCUSSION

Table 1 presents the food security availability indicators in terms of average value of food production and average dietary energy supply adequacy during 1991-2012. The average value of food production per capita increased consistently across all the four countries during the study period. It was the highest in Brazil, followed by South Africa, India and Bangladesh respectively. In Brazil, the average value of food production per capita was $ 363 in 1991, which rose to 675 in 2012. Meanwhile, its growth rate rose to 3.54 percent in 2010, which fell to 0.42 percent in 2012.

The food production value in South Africa had a negative growth of 1.25 percent in 2010, which remained stable in 2012. In absolute value, the average food production rose from 211 $ per capita in 2000 to 239 in 2010 and remained stable in 2012. In the case of India, average value of food production rose from $138 per capita in 1991 to $186 in 2012. From a growth rate of 1.36 percent in 2010, it declined to 0.67 percent in 2012. As regards Bangladesh, it rose from $95 per capita in 1991 to 138 in 2012. Its growth rate rose from 1.01 percent in 2000 to 2.54 percent in 2010, but decreased to 0.22 percent in 2012.

Table 1. Indicators of availability

Countries /Year	1991	2000	2010	2012
A. Average value of food production (1$ per capita)**				
Brazil	363	457	647	675
		(-2.59)	(-3.54)	(-0.42)
India	138	152	174	186
		(-1.08)	(-1.36)	(-0.67)
Bangladesh	95	105	135	138
		(-1.12)	(-2.54)	(-0.22)
South Africa	212	211	239	239
		(-0.05)	(-1.25)	0
B. Average dietary energy supply adequacy (%)				
Brazil	118	122	133	135
India	105	107	108	108
Bangladesh	99	104	107	108
South Africa	121	121	125	131

Note: ** Average value of food production measured using 2004-2006 as base year; and Brackets shows CAGR values

Source: FAO 2015. Rome.

The average dietary energy supply adequacy revealed an increase, showing almost a similar trend across the selected countries during 1991 to 2012. Brazil had the highest percentage adequacy (118) in 1991, which rose to 135 in 2012. It was followed by South Africa, with a 121 percent adequacy in average dietary energy supply in 1991, which increased to 131 percent in 2012. India had an average supply adequacy of 105 percent and Bangladesh of 99 percent, which rose to 108 percent in 2012 for both the countries. However, the increase has been slower relatively for India.

Table 2 records the food availability indicators in terms of growth rates of production and yield of major crops Viz. rice, wheat, cereals and pulses in Bangladesh and the IBSA countries during 1990-2000 to 2010-2014. All the countries are observed to have experienced a decrease in growth rates of the production and yield of the major crops over the nearly two and a half decade period under study, which is a disturbing feature, especially for the countries with increasing population growth rate. In Bangladesh, the growth rate in rice production declined from 49.44 percent in 1990-2000 to 8.36 percent in 2010-14. Growth rate in its yield during the same period fell from 61.35 percent to 26.03 percent. Wheat production had a very high growth rate during 2000-10 (271.42 %), which dropped to 1.47 percent in 2010-14. Meanwhile, its yield registered a negative growth rate (- 21.92 %) in 2010-14, from 81.47 percent growth in 2000-10. Growth rates in cereals and pulses production fell from 41.25 percent and 34.64 percent respectively in 1990-2000 to 34.91 and 4.22 percent respectively in 2010-14.

In the case of South Africa, growth rate in rice production fell from 32.74 percent in 1990-2000 to 4.66 percent in 2010-14, whereas its yield fell substantially from 55.3 percent to 2.2 percent respectively. Wheat growth rate in production recorded a fall from 42.08 percent to 23.01 percent during 1990-2000 to 2000-14. The corresponding decrease in its yield growth rate was 137.76 percent to 41.25 percent respectively. Cereals growth rates declined from 25.69 percent in 1990- 2000 to 17.52 percent in 2010-14, whereas its yield growth rate fell from 50.36 percent in 2000-10 to 4.28 percent in 2010-14. Growth rate in pulses production, which was negative over the two decades since

Table 2. Growth rates of production and yield of major crops

	Production			Yield		
Crops / Year	1990-2000	2000-2010	2010-2014	1990-2000	2000-2010	2010-2014
A. Brazil						
Rice	49.44	1.32	8.36	61.35	36.03	26.03
Wheat	-46.29	271.42	1.47	35.08	81.47	-21.92
Cereals	41.25	63.77	34.91	51.64	51.83	14.84
Pulses	34.6	3.74	4.22	47.14	31.41	12.17
B. India						
Rice	14.3	12.94	9.19	9.12	17.82	7.84
Wheat	53.2	5.81	16.93	30.99	2.2	6.69
Cereals	21.15	14.01	9.77	21.31	16.66	11.38
Pulses	6.66	25.69	15.92	28.25	-7.75	0.74
C. Bangladesh						
Rice	40.52	33.04	4.33	35.75	24.65	1.77
Wheat	106.74	-51.01	44.46	47.03	8.39	32.57
Cereals	42.37	31.29	6.18	35.89	26.71	2.74
Pulses	-25.26	-42.46	18.38	10.69	17.02	8.32
D. South Africa						
Rice	32.74	-4.13	4.66	55.3	- 13.1	2.2
Wheat	42.08	-41.11	23.01	137.76	-1.44	41.25
Cereals	25.69	1.18	17.52	46.77	50.36	4.28
Pulses	-30.21	-31.9	0.71	-9.2	-4.08	4.01

Source: FAO 2015. Rome (Values are calculated using growth rate formula)

1990-2000, turned positive (0.71 percent) during 2010-14. Its yield also turned positive (4.01 %) during the latter period, from its negative growth during the earlier two decades.

With respect to India, while rice, wheat and cereals production and yield growth rates registered a decline between 1990-2000 to 2010-14, pulses production recorded a higher growth rate, but its yield showed a decline. Rice production growth rate had a continuous decline from 14.30 percent in 1990-2000 to 9.19 percent in 2010-14, whereas its yield growth rate increased to 17.82 percent in 2000-10 and decreased to 7.84 percent in 2010-14. Meanwhile, growth rates in wheat production and yield dropped drastically during 2000-10 (5.81 % to 2.2 % respectively) and then recovered to 16.93 percent and 6.69 percent respectively during 2010-14. Cereals growth rate in production (21.15 %) and yield (21.31 %) declined consistently from 1999-2000 to 9.77 percent and 11.38 percent respectively during 2010-14. Growth rate in pulses production rose in 2000-10 (25.69 %) and again fell to 15.92 percent in 2010-14, whereas its yield growth turned negative in 2000-10 and again positive (0.74 %) in 2010-14.

As regards Bangladesh, growth rates in production and yield of rice recorded a consistent decrease from 40.52 percent and 35.75 percent respectively in 1990-2000 to a mere 4.33 percent and 1.77 percent respectively in 2010-14. Wheat growth rates in the production and yield fell in 2000-10 and rose again in 2010-14 from -51.01 and 8.39 percent to 44.46 and 32.57 percent respectively again. Growth rates in production and yield of cereals fell consistently between 1990-2000 and 2010- 14, from 43.37 to 6.18 percent and 35.89 to 2.74 percent respectively. On the other hand, growth rate in production of pulses, which was negative in 1990-2000 to 2000-10, became positive (18.38 %) in 2010-14. Its yield growth rate rose to 17.02 percent in 2000-10, but decreased again to 8.32 percent in 2010-14.

Human Development Index (HDI) and poverty ratios across IBSA and Bangladesh for 1990-2015 are shown in Table 3. The HDI has improved for all the four countries during the study period. It is the highest for Brazil, which improved from 0.608 in 1990 to 0.755 in 2014. For South Africa, the improvement was rather slow from 0.621 to 0.666 during the same period. Though comparatively lower, the improvement in HDI was relatively faster for India (from 0.428 in 1990 to 0.609 in 2014), than for Bangladesh (from 0.386 to 0.570 respectively).

The fall in poverty ratio was also almost consistent across all the four countries over the study period. Poverty ratio was the lowest in Brazil, at 35.79 percent in 1990, which fell to 9.10 percent in 2014. It was followed by South Africa, with a poverty ratio of 46.6 percent in 1990, which declined to 34.7 percent in 2015. For India, it was nearly eighty percent (79.8 %) of its population in 1990, which decreased by more than 20 percent in 2015. It was followed by Bangladesh which reported almost more than 82 percent of its population to be poor in 1990. However, it was able to reduce to it to 77.6 percent. This was possible due to the successful implementation of various poverty alleviation and employment generation programmes introduced by these countries.

Table 3. HDI and Poverty Ratio

Countries/Year	1990	2000	2010	2014#
A. HDI Values				
Brazil	0.61	0.68	0.74	0.76
India	0.43	0.50	0.59	0.61
Bangladesh	0.39	0.47	0.55	0.57
South Africa	0.62	0.63	0.64	0.67
B. Poverty headcount ratio at $3.10 a day (2011 PPP)*				
Brazil	35.79	25.82	11.37	9.10
India	79.62	73.46	57.96	58.00
Bangladesh	82.37	70.06	56.80	77.60
South Africa	46.67	49.97	34.68	34.70

Note: * Values in the data may not represent the values of the exact year and hence the most nearest available data is taken and Poverty ratio is in terms of percent of population

Source: World Bank 2015. WDI, Washington D.C.; and # Values taken from GFSI

Table 4 furnishes information on the economic accessibility indicators, in terms of GDP per capita, household consumption expenditure per capita and cost of domestic food, across the IBSA countries and Bangladesh during 1990, 2000, 2010 and 2014. Per capita income shows a substantial rise over the decades among the selected countries. Income has been the highest for South Africa between 1990 (US $3140.57) and 2000 (US $3037.21), which rose to US $7271.15 in 2010, but declined to $ 6481.84 in 2014 due to the impact of global economic crises. Meanwhile, the rise in per capita GDP of Brazil has been steady. It increased almost four fold from US $2705.56 million in 1990 to 11124.08 million in 2010, over the two decades, and again to 11386.58 million in 2014. Bangladesh had one of the lowest per capita GDP, amounting to US $265.49 million in 1990. It rose steadily to $1087.91million (2014) over the next 24 years. India has been better with a per capita GDP of $367.96 million in 1990, which gradually rose to 1586.47 million in 2014.

The household per capita final consumption expenditure in US $ was one of the highest for Brazil at 6697.63 in 2010, which further rose to 7336.80 in 2014. This was followed South Africa, with a per capita expenditure worth $3318.11 in 1990, which had a slow growth to 3425.18 in 2000, 4363.16 in 2010 and stood at 4634.30 in 2014. Although Bangladesh had higher per capita expenditure in 1990 (US $375.14) than India (US $360.47), in the rest of the years the latter's per capita expenditure was higher. It was US $5190.33 in 2000, which rose to 777.43 in 2010 and again to 963.99 in 2014 for India. Meanwhile, the growth in per capita expenditure was slower in Bangladesh, which increased from US $410.69 in 2000 to 563.52 in 2010, and again to 651.09 in 2014.

Table 4. Economic Accessibility Indicators

Countries/Year	1990	2000	2010	2014
A. GDP per capita (US $ Millions)				
Brazil	2705.556	3711.095	11124.08	11386.58
		(-3.21)	(-11.6)	(-0.23)
India	367.9635	435.2818	1355.637	1586.47
		(-1.69)	(-12.03)	(-1.58)
Bangladesh	265.4816	346.3538	755.2449	1087.907
		(-2.69)	(-8.11)	(-3.72)
South Africa	3140.565	3037.213	7271.148	6481.836
		(-0.33)	(-9.12)	(-1.14)
B. Household final consumption expenditure per capita (constant 2010 US $)*				
Brazil	4143.937	5190.334	6697.63	7336.8
		(-25.25)	(-29.04)	(-9.54)
India	360.4737	480.9495	777.4302	963.9914
		(-33.42)	(-61.64)	(-24)
Bangladesh	375.1362	410.693	563.5174	651.0949
		(-9.48)	(-37.21)	(-15.54)
South Africa	3318.112	3425.177	4363.162	4634.299
		(-3.23)	(-27.39)	(-6.21)
C. Domestic Food Price Index				
Brazil	N.A.	2.28	2.38	2.61
India	N.A.	4.91	4.83	4.68
Bangladesh	N.A.	8.11	8.39	7.99
South Africa	N.A.	2.13	2.92	3.04

Note: N.A – Not Available; and Brackets shows CAGR values
*Source: FAO 2015. Rome; and *World Bank 2015. WDI, Washington D.C.*

Domestic food price index is observed to be continuously rising during 2000-14. It was found to be the lowest for South Africa, followed by Brazil. Whereas, it emerged to be the highest for Bangladesh, followed by India. In South Africa, it rose from 2.13 in 2000 to 3.04 in 2014. Meanwhile in Brazil, the rise was rather from with 2.28 in 2000 to 2.61 in 2014. For India also, it declined very slowly from 4.91 to 4.68 respectively. In the case of Bangladesh, it rose to 8.39 in 2010 and again dropped to 7.99 in 2014.

Table 5 illustrates the outcome of accessibility to food security the four countries for the period 1991-2015, in terms of depth of food deficit, prevalence of undernourishment and prevalence of food inadequacy. Depth of food deficit per day shows it to be one of the lowest in South Africa, which decreased from 33 kilo calorie (kcal) per capita in 2000 to 13 in 2015. The decline in growth rate was 5.95 percent in 2015. It was followed by Brazil, with 110 kilo calorie per capita food deficit in 1991, that significantly fell to 10.0 in 2015, registering a negative growth rate of 16.59 percent in 2010, which a further decline to 3.97 percent in 2015. Bangladesh and India have much higher food deficit depth compared to the other two IBSA countries. For India, it fell from 165 kcal in 1991 to109 per capita per day, declining at a slow pace of 0.52 percent in 2010 to 0.27 percent in 2015. As regards Bangladesh, the fall was much sharper from 247 kcal in 1991 to 116 in 2015, falling at a rate of 4.37 percent in 2000 to 0.34 percent in 2015.

The percent prevalence of food inadequacy declined almost across all the countries during the study period. Once again the decrease was the largest in South Africa, which rose to 10 percent in 2000, but declined consistently after that to less than 5.0 percent in 2015. Brazil followed with consistent decline from 21.7 percent in 1991 to less than 5.0 percent in 2015. India stood next, experiencing a fall from 33.1 percent in 1991 to 25.7 percent in 2000, after which the decline was very slow, reaching 24.3 percent in 2015. Bangladesh had higher percentage of food inadequacy than India, which declined from 41.2 in 1991 to 26 in 2015.

Table 5. Outcomes of Accessibility

Countries /Year	1991	2000	2010	2015
A. Depth of the food deficit (kcal/caput/day)				
Brazil	110	92	15	10
		(-1.97)	(-16.59)	(-3.97)
India	165	118	112	109
		(-3.66)	(-0.52)	(-0.27)
Bangladesh	247	158	120	116
		(-4.84)	(-2.71)	(-0.34)
South Africa	30	33	24	13
		(-1.06)	(-3.13)	(-5.95)
B. Prevalence of food inadequacy (%)				
Brazil	21.7	19	5.4	<5.0
India	33.1	25.7	24.9	24.3
Bangladesh	41.2	33.3	26.8	26
South Africa	9.3	10	7.9	<5.0
C. Prevalence of undernourishment (%)				
Brazil	14.8	12.3	<5.0	<5.0
India	23.7	17	15.7	15.2
Bangladesh	32.8	23.1	17.2	16.4
South Africa	<5.0	<5.0	<5.0	<5.0

Source: FAO 2015. Rome; and Brackets shows CAGR values

The prevalence of undernourishment decreased consistently across the selected countries during 1991 to 2015. The achievement of South Africa was remarkable, achieving less than 5.0 percent under-nourishment from 1991 onwards and remaining stock it till 2015. Undernourishment in Brazil declined from 14.8 in 1991 to less than 5.0 percent since 2010 to 2015. Meanwhile, India and Bangladesh achieved a consistent decrease during 1991 and 2015, from 23.7 to 15.2 percent by the former and from 32.8 to16.4 percent by the latter. Between them, the rate of decrease was greater in the case of Bangladesh.

Table 6 reports five indicators of absorption for IBSA and Bangladesh for the period 1990 to 2015. Access to improved water shows a rise during 1990 to 2015. Access to improved water registered a rise from 76.08 percent to 90.97 percent at world level. Among the countries, Brazil had the highest percentage of access to improved water, with 88.5 in 1990, reaching almost cent percent in 2015 (98.1 %). Although South Africa reported higher access to improved water in 1990 (82.8 %), it stood next to India (94.1%) in 2015 at 93.2 %. Bangladesh also improved its accessibility to improved water from 68.1 percent to 86.9 percent respectively. Meanwhile, world access to improved sanitation increased from 52.9 percent in 1990 to 6.52 percent in 2015. Only Brazil had a higher percentage of access to improved sanitation than the world level, with 66.6 percent in 1990, rising to 82.8 percent in 2015.

Table 6. Indicators of Absorption

Countries/year	1990	2000	2010	2015
A. Access of improved water (%)				
Brazil	88.5	93.5	96.9	98.1
India	70.5	80.6	90.3	94.1
Bangladesh	68.1	76	83.5	86.9
South Africa	82.8	86.5	91.1	93.2
World	76.1	82.5	88.4	91
B. Access to improved sanitation (%)				
Brazil	66.6	74.7	80.5	82.8
India	16.8	25.6	35.5	39.6
Bangladesh	34.4	45.4	55.8	60.6
South Africa	51.4	57.2	63.5	66.4
World	52.9	58.8	64.9	67.5
C. Prevalence of anaemia among pregnant women (%)**, #				
Brazil	41.8	35.5	32.4	32.4
India	51.8	55	53.9	53.6
Bangladesh	53.5	51.7	48.2	48.1
South Africa	35.1	32.6	30	29.7
D. Prevalence of anaemia among children under 5 years (%)#				
Brazil	37.2	22.8	22.7	23.6
India	75	68.1	60	59
Bangladesh	73.5	64	56.3	55.6
South Africa	29.6	32.5	40.3	40.6
E. Infant mortality rate (per 1,000 live births)				
Brazil	50.9	28.1	14.8	14.6
India	88.3	66.4	46.3	37.9
Bangladesh	99.7	64.4	39.2	30.7
South Africa	47.4	54	38.2	33.6

Note: For year 2015, the latest available datasets of 2011 is being used
*Source: World Bank 2015. WDI, Washington D.C. and ** FAOSTAT 2015. FAO, Rome*

As regards prevalence of anaemia among pregnant women, it decreased over the study period in all countries, except India. It was the lowest in South Africa at 35.1 percent in 1990, which declined to 30 in 2010. It was followed by Brazil (41.8% and 32.4%), Bangladesh (53.5% and 48.2%) respectively, and India with a rise to 55 percent in 2000, which fell to 53.9 percent in 2010. Although prevalence of anaemia among children under five was one of the lowest in South Africa (29.6%) in 1990, it was the lowest in the Brazil from 2000 (22.8%). It decreased to 2010 (22.7%), though the decadal decline was almost stable. India had the highest anaemia among children from 1990 (75%) to 2010 (60%). Meanwhile, the corresponding figures in Bangladesh were 73.5 and 56.3 percent.

Infant mortality rate per 1000 live-births show that although South Africa had one of the lowest figures in 1990 (47.4), followed by Brazil (50.9), by 2015 the latter had the lowest infant mortality (14.6). Bangladesh, which had the highest infant mortality in 1990 (99.7), had the second lowest in 2015 (30.7). South Africa followed next with 33.6 deaths per 1000 live births. Whereas, India which had the second highest infant mortality rate in 1990 (88.3), was the last in 2015 (37.9) with higher infant mortality among the four countries.

Table 7 presents the Global Food Security Index over the period 2012 to 2016. It reveals the food security index to be the highest and stable at nearly 67 for Brazil throughout the study period. It was followed by South Africa whose index improved from 60.8 in 2012 to 62.9 in 2016. Next was India, whose index improved from 48.7 to 49.4 respectively. Bangladesh had relatively lower index, with a corresponding status of 34.7 to 36.8 in 2016.

Table 8 presents the OLS regression results of the prevalence of food inadequacy function. An increase in GDP per capita was observed to significantly reduce prevalence of food inadequacy in Brazil. Whereas, contrary to expectation, it was found to increase food inadequacy in the remaining countries. This could be due to the vast income inequalities prevailing in these countries. The association also emerges significant for India. Increased population growth rate increases food inadequacy, which emerges significant only for Brazil. However, the positive relationship is insignificant for Bangladesh and South Africa. Contrary to the hypothesized association its influence is negative, but insignificant for India. Increased total food import was negatively associated with food inadequacy for India and South Africa, which emerges insignificant. The negative association implies decline in food inadequacy as a result of food imports. However, in the case of Bangladesh and Brazil, contrary to the expected association the impact was found to be positive, which emerges significant only for Brazil. Rise in average value of food production is found to significantly decrease food inadequacy for all the four countries, except South Africa. This could be because a rise in the value of food production would also encourage more food production, which in turn, would increase food availability, thus reducing food inadequacy.

The implementations of targeted food security policies are observed to significantly reduce food inadequacy in India and Brazil, implying that the PDS scheme in the former and Zero Hunger program in the latter are working efficiently in overcoming the food inadequacy problems in the two countries. Whereas, in Bangladesh and South Africa the relationship emerges insignificant and contrary to the expected association, implying that food security schemes in these countries are yet to achieve the desired targets.

Table 7. Global Food Security Index

Countries/Year	2012	2013	2014	2015	2016
Brazil	67.8	67.7	67.6	66.8	67.6
India	48.7	48.2	47.9	48.9	49.4
Bangladesh	34.7	35.0	35.4	36.0	36.8
South Africa	60.8	61.0	62.3	62.3	62.9

Source: Global Food Security Index 2016. The Economist Intelligence Unit, New York.

Table 8. OLS Regression results: Prevalence of food inadequacy function

Variables	India	Bangladesh	Brazil	South Africa
CONST	70.212	132.155	48.644	48.203
	(1.57)	(1.57)	(2.45)**	(3.13)*
GDPPC	5.955	9.294	-2.901	0.562
	(2.30)**	(0.53)	(5.23)*	(0.36)
POPGR	-5.890	1.824	8.187	1.831
	(0.90)	(0.68)	(3.41)*	(0.84)
FOODM	-1.334	7.373	3.341	-1.695
	(0.90)	(0.21)	(6.22)*	(1.36)
AVFPD	-0.271	-1.300	-15.164	-0.038
	(4.79)*	(9.86)*	(4.82)*	(1.19)
UEMPR	1.087	-2.059	0.030	-0.137
	(0.69)	(2.84)*	(0.24)	(1.11)
POLCY	-3.884	0.163	-2.569	1.606
	(2.80)*	(0.11)	(5.23)*	(0.67)
$\bar{R}^2$	0.823	0.973	0.996	0.717
F- Value	20.428*	148.820*	1102.686*	11.565*

Note: Brackets show t-values; and *, **, *** indicate significance at 1, 5 and 10% levels respectively.

The included explanatory variables in the regression model together explain about 72 to more than 90 percent variations in the dependent variable for the four countries. The model fit emerges more perfect for Brazil than for rest of the countries. The F-value indicates the overall model fitted to be significant for all the four countries.

CONCLUSION

Using data drawn from FAOSTAT, WDI and Global Food Security Index, the paper analyses the trends in food security indicators and determinants of prevalence of food inadequacy among the IBSA countries and Bangladesh during 1990 to 2016. The indicators of availability revealed that while average volume of food production increased in absolute terms, its growth rate declined across the IBSA countries and Bangladesh during 1991 to 2012, which is quite disturbing. In the case of all other indicators of food security, Brazil's achievement was observed to be relatively much better, whereas India and Bangladesh are found still lagging behind.

The determinants of prevalence of food inadequacy revealed increased per capita income to be significantly reducing food inadequacy in Brazil, whereas population growth rate increased it. Increase in value of food production was observed to reduce food inadequacy in all the countries, except South Africa. Likewise, and implementation of targeted food security policies was found to significantly decrease food inadequacy in Brazil and India.

The study recommends increased food production and effective implementation of the food security schemes by the selected countries. The declining trends in food production and yield warrants urgent attention on the issue, through 'measures of investment in agricultural research, outreach and extension services to share latest technological know-how, and dissemination of market information to farmers, besides strengthening irrigation infrastructure. These countries can also benefit from sharing their best experiences with each other.

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